Faculty of Mechanical and Manufacturing Engineering Technology

DESIGN AND SIMULATE WATER VAPOR FLOW IN HEAT EXCHANGER BY VARYING DIAMETER

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This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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ABSTRACT

The title of this project is ―Design and Simulate Water Vapor Flow in Heat Exchanger by Varying Diameter". This research will be focused on parameter of heat exchanger analysis and heat exchanger model to optimize the heat transfer value. This research is to study and analyse the simulation of vapor flow by using CFD analysis (Altair Hyperworks, AcuSolve), SolidWorks, CATIA and compare analytical. Besides that, this research and analysis will be focus on the size (diameter) of heat exchanger by using helical coil design. Through the research, the selection and design method that is suitable type for material, size (diameter, length, pitch) for heat exchanger was decided. The result of this research will be the best heat exchanger design chosen that will increase the rate of heat exchanger based on the best diameter used and it will be more portable from previous heat exchanger design

ABSTRAK

.Tajuk projek ini ialah "Merekabentuk dan Mensimulasikan Aliran Wap Air dalam Penukar Haba dengan Mengubah Diameter". Kajian ini akan memberi tumpuan kepada parameter analisis penukar haba dan model penukar haba untuk mengoptimumkan nilai pemindahan haba. Kajian ini adalah untuk mengkaji dan menganalisis simulasi aliran wap dengan menggunakan analisis CFD (Altair Hyperworks, AcuSolve), SolidWorks, CATIA dan membandingkan analisis. Selain itu, kajian dan analisis ini akan memberi tumpuan kepada saiz (diameter) penukar haba dengan menggunakan reka bentuk gegelung heliks. Melalui penyelidikan, kaedah pemilihan dan reka bentuk yang sesuai untuk bahan, saiz (diameter, panjang, padang) untuk penukar haba diputuskan. Hasil penyelidikan ini akan menjadi reka bentuk penukar haba terbaik yang dipilih yang akan meningkatkan kadar penukar haba berdasarkan diameter terbaik yang digunakan dan ia akan menjadi lebih mudah alih dari reka bentuk penukar haba sebelumnya.

DEDICATION

I dedicate this report to my cherished guardians Mr. Zulkefli bin Ab Rahman and Mdm Nooritai bt Sha'ari. Not forgot to my supervisor, Mr. Muhammad Nur bin Othman and my automotive studio analysis laboratory technician , Mr Mohamad Azrul bin Mamat that give me chance to use laboratory under his supervision. I also want to dedicate this dissertation to my lecturer Mr Mohd Suffian bin Ab Razak who will to teach me and assist me to complete this research. And for my friends Muhamad Farhan Azhar bin Abdul Murad and Muhamad Ramdan bin Komaruddin for giving the assistant and underpins in completing this study.

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LIST OF SYMBOLS

D, d	-	Diameter
°C	-	Temperature
m	-	Metre
hr	-	Time
1	-	Length
K	-	Thermal conductivity
Re	-	Reynold number
V	-	Velocity
r	-	Radius
De	-	Dean number

LIST OF ABBREVIATIONS

CAD	Computer Aided Design
HCPV	High Concentration Photovoltaic
G.I.	Galvanized iron
RPF	Reinforced plastic
CAE	Computer Aided Engineering
FEM	Finite Element Model
CFD	Computational Fluid Dynamics
FEA	Finite Element Analysis

CHAPTER 1

INTRODUCTION

The reason of this study is to design or create and simulate the stream of vapour within the heat exchanger. The heat exchanger is important or most critical parts that will play an imperative part in arrange to be able to optimize the whole amount of distillate. The selection design of heat exchanger will incorporate comparison between some designs of heat exchanger to choose or pick the most suitable heat exchanger to be simulated.

1.1 Background

In this modern area, the world demand of energy for life. Energy is defined as the ability or the capacity to do work and it can be split by two types which is renewable and non-renewable energy. The energy that is generated from natural processes that are continuously replenished is called renewable energy. The examples of this energy are sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed. The main advantage of this energy is it is a clean source of energy, meaning, it has low or zero carbon and greenhouse emission.

Human can only survive for only one week without water compared to three weeks without food. Based on fact that human body are made up of 60 percent of water in order to keep the entire cell in the human body functioning. But if the problems of clean water source continue limited, the number of human population will decrease and it will also affect the environment, animal and various plants in the earth.

To overcome this problem, there are several method are produced to create the clean water to consume. Based on the research, the existing methods are mostly big, difficult and expensive. Recently, a new method that is created by using Fresnel lens as solar collector or to achieve the boiling point and from this method the vapor will be produce and it will condense using a heat exchanger then it will collected to the reservoir or clean water tank.

There are many methods that can be used to produce clean water by use method of heat exchanger. For example is by using Fresnel lens water distiller. Fresnel lens is made up of thin plastic sheet containing grooves which are specifically design to deflect light. The solar concentrator uses a Fresnel lens and a special Fresnel-type lens that allows the system to work without a solar tracker. The concentrated solar rays are directed to the boiler where the non-potable water is converted into steam, leaving behind any sort of impurities. So the clean water produced using this process.

Another alternative source of renewable energy that currently used in most factories is solar energy. Solar energy is energy created by the heat and light of the sun. Solar power is produced when this energy is converted into electricity or used to heat air, water, or other substances. Solar power systems have a very small number of moving parts, run silently, are highly reliable and require almost no maintenance. Besides, solar energy can contribute a major role for extensive variety of utilization such as solar distillation, solar water heater, solar cooker, solar desalination energy generation and solar pumps.

The operated of heat exchanger by using distillation process can be defined as measures to separate and extract clean water by vaporization process. The function is to turn seawater, river water or even pipe water into clean water that is safe to drink. Heats from the sun can evaporate water, then at the same time it will separate the salt, dirt of

the dirt water. After that, it will turn the vapor to liquid. Moreover, a solar distillation system with the addition of Fresnel lens will increase the heating rate of contaminated water in which will result of clean water produced in a short period of time.

This research is to study the flow or the stream of vapor analysis in the heat exchanger by using Altair Hyperworks to analyze and validate. A heat exchanger may be a device utilized to exchange warm between two or more liquids. The liquids can be single or two stages and, depending on the exchanger sort, may be isolated or in coordinate contact. This device is including vitality sources such as atomic fuel pins or terminated radiators are not regularly respected as warm exchangers in spite of the fact that numerous of the standards included in their plan are the same. The classic example of a heat exchanger is found in an inner combustion motor in which a circulating liquid known as motor coolant streams through radiator coils and discuss streams past the coils, which cools the coolant and warms the approaching discuss. Another case is the heat sink, which could be a detached warm exchanger that exchanges the warm produced by an electronic or a mechanical device to a liquid medium, regularly discuss or a fluid coolant.

The heat exchanger materials divide the medium being used and transfer the heat by conduction and convection. The process that include in this distillation process is condensation and evaporation. Day by days there are new improvement that have been made to make a best heat exchanger to produce maximum amount of distillate.

HyperWorks provides the most comprehensive, open-architecture CAE solution in the industry, including best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications. Committed to an open-systems

philosophy, Altair HyperWorks continues to lead the industry with the broadest interoperability to commercial CAD and CAE solutions in the PLM market space..

1.2 Problem Statement

All of the available equipment today is mostly depend on fossil fuel during it operational period. Moreover, the main problem of using fossil fuel is that the source is non-renewable. It means that the energy is valid for one time usage only and will become extinct at some point. Other than that, for the place such as beach the water supply is limited. So when the water is needed for critical or emergency use, in that case solar desalination will take place. Desalination alludes to the method where salt and other minerals are evacuated from water. For this prepare, the Sun warms and dissipates water, which at the same time is isolated from salt, soil or anything else for that matter. When the temperature and weight is right, the water atoms changes and returns to fluid. Other than that the previous water distiller is more expensive and more installation process. Since all nature in the earth especially needs water for life, so in order to optimize the amount of distillate the improvement of heat exchanger need to make.

1.3 Objective

The objectives of the present research are as follows:

i. To design heat exchanger that will optimize the amount of heat transfer

ii. To analyze the flow of vapor in heat exchanger

1.4 Scope

This study will focus on the design and simulate the flow of vapor in heat exchanger. Below are the listed scopes of this project:

i. Redesign the heat exchanger using CATIA software

ii. Study the flow of vapour using Hyperworks to analyse

iii. Focus on optimization of the heat exchanger design by checking using Hyperworks

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews about the heat exchanger that is function to convert the steam that produces when boiling process of water then it will be distilled and collect clean container. Distillation is the method of isolating the components or substances from a fluid mixture by particular boiling and condensation. The distillation of water by solar power can be defined as measures to separate and extract clean water by vaporization process. The heat exchanger materials divide the medium being used and transfer the heat by conduction and convection. It means that water is heated to its boiling point, and then the steam produced is collected and condense back into liquid form when passing through the heat exchanger. There are many factors that will affect the efficiency of the amount of distillate which are design, diameter, material, size and length.

2.2 Heat Exchanger

According to (Ahire, Shelke, Shinde, Totala, & Professor, 2014), a heat exchanger could be a device used to exchange warm between two or more liquids with different temperatures for different application including power plants, atomic reactors, refrigeration & air condition framework, car businesses, warm recovery system, chemical preparing and nourishment businesses. The essential concept of a heat exchanger is based on the introduce that the misfortune of warm on the tall temperature side is precisely the same as the warm picked up within the moo temperature side after

the warm and mass streams through the heat exchanger (Patel, Sen, & Sahu, 2016). (Pontevedra, 2018) said that heat exchangers are utilized for exchanging warm vitality between two or more liquids, or strong particulates and a liquid, at diverse temperature and in warm contact. The fundamental rule of a heat exchanger is that it exchanges the heat without exchanging the liquid that carries the warm. In heat exchangers, there are no outside warm vitality and work intelligent. The heat exchange happens basically due to conduction and convection. The heat exchangers are classified agreeing to exchange forms, number of fluids, and degree of surface compactness, development highlights, flow courses of action, and warm exchange mechanisms.

2.3 History of Heat Exchanger in Distillation Process

By definition, distillation is the activity of filtering a fluid by a handle of warming and cooling. This implies that the fluid (in this case water) is warmed past the bubbling point, and at that point the steam is collected and condensed back into a fluid. During this process, all solids suspended in the water, will be left behind at the bottom of the container where the boiling took place, thus making the distilled water safe to drink(Aramayo, Lopez, & Mowatt, 2015).

Figure 2-1: Distillation using an alembic in 8th century described by Jabir B Hayyan

The Persians practiced refining at the restorative school in Jundishapur within the 6th century, where it was utilized to create herbal tinctures. The Middle easterners utilized expansive, expound stills to form rosewater and other home grown compounds, and to conduct innovative alchemical tests within the 9th and 10th centuries, making solvents for base metals conjointly endeavouring to find an ~~–e~~lixir of life." They clearly succeeded in refining spirits, for the artist Abu Nuwas portrayed a wine that ~~–h~~as the color of water but is as hot interior the ribs as a burning firebrand."

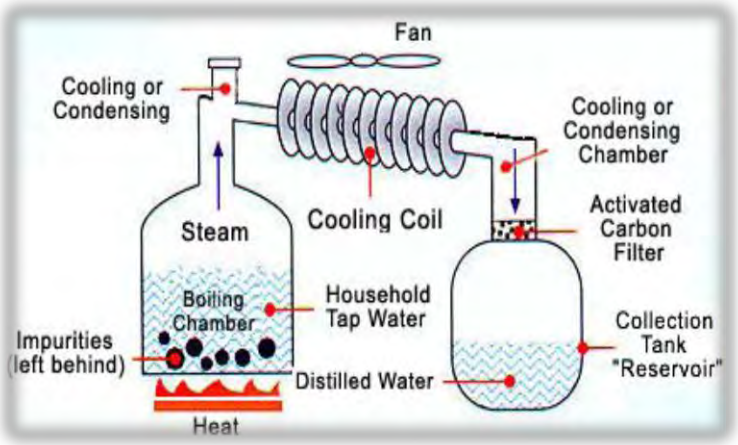

Figure 2-2: Distillation Process (Aramayo et al., 2015)

The direct warm or beams from the sun accelerate this -alter of the fluid into an undetectable vapor (Fairley, 1907) . The distillation of sea water happen very long time ago which is about AD 200, Aristotle state in his Metrology that the vaporization process that made by sea water will produce clean water that can be drinkable.